INSTITUTE REPORT NO. 446

The Effect of Ballistic Laser Protective Goggles on TOW Missile Launcher Tracking

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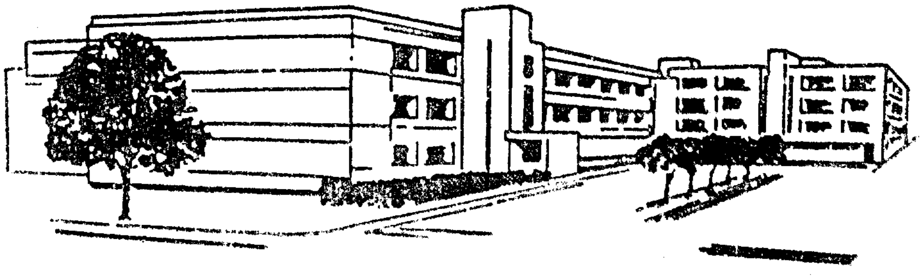
January 1990



LETTERMAN ARMY INSTITUTE OF RESEARCH PRESIDIO OF SAN FRANCISCO CALIFORNIA 94129

The Effect of Ballistic Laser Protective Goggles on TOW Missile Launcher Tracking (Institute Report No. 446) -- D.A. Stamper, et al.

Human Subjects participated in these studies after giving their free and informed voluntary consent. Investigators adhered to AR 70-25 and USAMRDC Reg 50-25 on the use of volunteers in research.

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT UNLIMITED DISTRIBUTION
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Institute Report No. 446	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Letterman Army Institute of Research 6b. OFFICE SYMBOL (If applicable) SGRD-ULE-OH	7a. NAME OF MONITORING ORGANIZATION US Army Medical Research and Development Command
6c. ADDRESS (City, State, and ZIP Code) Letterman Army Institute of Research Division of Ocular Hazards Presidio of San Francisco, CA 94129-6800	7b. ADDRESS (City, State, and ZIP Code) Fort Detrick Frederick, MD 21701-5012
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
	3E162 777A878		161

11. TITLE (Include Security Classification)

The Effect of Ballistic Laser Protective Goggles on TOW Missile Launcher Tracking

12. PERSONAL AUTHOR(S)

David A. Stamper, Bruce E. Stuck, G.R. Mastroianni, David J. Lund, Jerome W. Molchany

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Laboratory	FROM Aug 89 TO Sep 89	1990,Jan	35

16. SUPPLEMENTARY NOTATION

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

Laser; Laser Protection; Human, Performance, Pursuit Tracking

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The introduction of laser rangefinders and designators as adjuncts to weapon systems on oday's modern battlefield creates a high probability for ocular injury. The short -term solution to this problem is the Ballistic Laser Protection System (B-LPS) , a set of polycarbonate eye spectacles designed to provide laser and ballistic protection without degrading performance. Pursuit tracking performance of eight male volunteers wearing the B-LPS was measured using a modified TOW missile launcher under both bright light and dawn/dusk ambient light conditions. On the test day each volunteer received five baseline trials, and five trials with each of the B-LPS, the clear ballistic lens, the green laser protective frontsert, and the brown sunglasses. One additional prototype filter designated as the prime color filter was also evaluated. Analysis of Variance and the post hoc comparisons of the horizontal Root Mean Square (RMS) error scores found no significant differences among the filter conditions under bright light conditions, but under dawn/dusk conditions significantly increased error scores were found compared to the bright light trials. (continued on reverse)

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Donald G. Corby, COL, MC	22b. TELEPHONE (Include Area Code) (415) 561-6300 22c. OFFICE SYMBOL SGRD-ULE-Z

DD Form 1473, JUN 86 *Previous editions are obsolete.*

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

block 19 continued

The scores for the green laser frontsert spectacles were significantly higher than the baseline, clear spectacles, and the sunglasses under the dawn/dusk conditions. The subjective reports obtained using the Field Assessment of Laser Protective Spectacles (FALOPS) Questionnaire were not significantly related to tracking performance. The present findings indicate that under good visibility none of these materials should significantly degrade performance. However, under limited visibility conditions, differences can be expected.

ABSTRACT

The introduction of laser rangefinders and designators as adjuncts to weapon systems on today's modern battlefield creates a high probability for ocular injury. The short-term solution to this problem is the Ballistic Laser Protection System (B-LPS), a set of polycarbonate eye spectacles designed to provide laser and ballistic protection without degrading performance. Pursuit tracking performance of eight male volunteers wearing the B-LPS was measured using a modified TOW missile launcher under both bright light and dawn/dusk ambient light conditions. On the test day each volunteer received five baseline trials, and five trials with each of the three components of the B-LPS, the clear ballistic lens, the green laser protective frontsert, and the brown sunglasses. One additional prototype filter designated as the prime color filter was also evaluated. Analysis of Variance and the post hoc comparisons of the horizontal Root Mean Square (RMS) error scores found no significant differences among the filter conditions under bright light conditions, but under dawn/dusk conditions significantly increased error scores were found compared to the bright light trials. The scores for the green laser frontsert spectacles were significantly higher than the baseline, clear spectacles, and the sunglasses under the dawn/dusk conditions. The subjective reports obtained using the Field Assessment of Laser Protective Spectacle (FALOPS) Questionnaire were not significantly related to tracking performance. The present findings indicate that under good visibility none of these materials should significantly degrade performance. However, under limited visibility conditions, differences can be expected.

DEDICATION

This report is dedicated in memory of COL Edwin S. Beatrice who recognized the problem of the laser threat over fifteen years ago and provided us with the guidance and support that has enabled us to now provide protection for our troops in the field.

TABLE OF CONTENTS

LIST OF FIGURES

TITLES OF TABLES

The Effect of Ballistic Laser Protective Goggles on TOW Missile Launcher Tracking -- Stamper, et al.

INTRODUCTION

The eye plays a critical role in the success of many military tasks (e.g., detection, recognition, tracking). On the modern integrated battlefield laser rangefinders and designators used by friendly as well as threat forces will play an important role in determining the outcome of battles where they are used. Current threat analyses of these laser devices indicate that they will be used in an antisensor mode (1). Wargame assessments suggest that the laser devices will be a highly effective force multiplier (2). Among the sensors of immediate concern is the human eye. When a soldier is required to look through magnifying optics (e.g., tank gunners sights, TOW missile launchers) the laser's potential hazard is increased by a factor equal to the square of the optic magnification of the optics. With the wide range of possible frequencies it is presumed that when these devices are used in an antipersonnel mode they will be effective in masking targets and producing medical casualties (3).

Many of the currently fielded weapon systems with optical magnification have been in the inventory for as long as 20 years. These systems were manufactured before the laser eye threat had been acknowledged as a significant battlefield problem. Programs are underway to include laser hardening in new systems and to retrofit existing systems with laser protection.

The protection of our soldiers' eyes is a major objective of the US Army Medical Research and Development Command and the Letterman Army Institute of Research. While providing protection to substantially reduce medical casualties and related costs is recognized, this protection must not degrade a soldier's ability to perform his tasks. The Division of Ocular Hazards previously evaluated early prototype laser filters both in the laboratory and in the field. This evaluation program has yielded a Ballistic Laser Protective System (B-LPS) that is currently being issued to critical field units.

The design and manufacturing specifications established for the B-LPS required protection against laser radiation and ballistic fragments, but also stipulated that this protection must not be accomplished at the expense of degraded visual performance. The current evaluation by troops in the field will provide some insight into user acceptability. However, until information from large scale force-on-force tests is available, performance measures from studies such as those which evaluated the early prototype filters must continue to provide the necessary feedback to assist in the future modifications and improvements of the B-LPS.

Selecting an appropriate performance task sensitive to possible degradation of the visual scene is critical for assessing the effect of laser protective eyewear on soldiers' performance. As noted above, while in the field soldiers perform a variety of important visual tasks which may be affected by wearing laser protective eyewear. The task selected for evaluation must not only be representative of other military jobs, but should also be easily quantifiable. The task should also depend mainly on visual processes and should not be complicated by other factors (e.g., decision processes). When the data are evaluated, any differences which are found for this task should apply to a variety of military tasks. The pursuit tracking task performed by TOW gunners for various luminance conditions meets these requirements.

The present study evaluated the effects of wearing the B-LPS goggles on pursuit tracking performance using a modified TOW missile launcher in the field (one additional filter called the prime color filter was also tested, see below). The volunteers tracked a moving target 2150m down range under both bright and dawn/dusk conditions. Variability in tracking accuracy was measured with and without the use of the B-LPS and was statistically evaluated with an Analysis of Variance. Subjective impressions while wearing the B-LPS and tracking the target were recorded using the Field Assessment of Laser Optical Protective Spectacles Questionnaire immediately following completion of the tracking session (See Appendix).

MATERIALS AND METHODS

Volunteers: Eight military and civilian volunteers from the Division of Ocular Hazards who ranged from 23 to 52 years of age participated in this study. All participants were briefed on the purpose of the study and the experimental procedures involved. They were then requested to sign a volunteer agreement form to acknowledge that all procedures and attendant risks had been thoroughly explained and that participation in this study was voluntary. To insure that all volunteers fell within normal limits of visual performance a visual clinical battery consisting of the Farnsworth-Munsell 100-Hue Test, the Ishihara Test for Color Blindness, the Arden Test of Contrast Sensitivity, and dark-adaptation testing were administered. High contrast visual acuity was also tested with the Snellen Eye Chart. Visual acuity of 20/20 or better was required for each volunteer (four of the eight volunteers wore contacts or corrective lenses to meet these requirements). All subjects were judged to be within normal limits on each of the tests prior to participation in the study.

Apparatus: Pursuit tracking performance was measured using a modified TOW missile launcher tracking system. This system was used extensively in earlier studies which evaluated some of the early prototype laser ocular protection materials (4). Briefly, the volunteer tracked a moving target down range and a microprocessor monitored the analog error tracking signals normally used to direct the TOW missile. The signals were then digitized and stored on a disk drive in the digitized format. Statistical evaluation of these data provided information concerning tracking variability for each person.

Filters: Each person received 25 trials (five trials for each of the five filter conditions) under both bright light and dawn/dusk light conditions. The five filter conditions were: 1) Baseline (no filter), 2) Clear Polycarbonate B-LPS shields, 3) B-LPS Laser Frontsert, 4) B-LPS Sunglasses, and 5) Prime Color Spectacles.

Radiant transmission measurements were made for the B-LPS Laser Frontserts, B-LPS Sunglasses, and the Prime Color Spectacles and are presented in Fig. 1. The transmission of the sunglasses was relatively flat across the visible spectrum. The transmission of light in the red region of the light spectrum was dramatically reduced by the B-LPS Laser Frontsert. The Prime Color Spectacles showed three distinct transmission peaks in the blue, green, and red regions of the visible light spectrum. The luminous transmission and chromaticity coordinates for each filter were computed from the radiant transmission data using the relationship:

$$LT = \frac{\int_{380}^{730} T_\lambda V_\lambda S_\lambda d_\lambda}{\int_{380}^{730} V_\lambda S_\lambda d_\lambda}$$

Where: T_λ = radiant transmission at wavelength
V_λ = CIE standard observer function
S_λ = CIE Standard Source function (CIE-C)

The overall photopic and scotopic luminous transmission values obtained for the three filters made in order from highest to lowest were: (1) B-LPS Frontserts 47 and 56%, (2) B-LPS Sunglasses 22 and 16%, and (3) Prime Color Spectacles 12.7 and 6.9% respectively.

The spectral irradiances of the target and background were obtained with an Imaging Spectroradiometer (Optronics Laboratory, Model 740A(740 A-D/740-1C/IBM PC) Orlando, Florida). Dawn/dusk values were calculated from the following equation:

$$L_D = L_B * \log^{(-2.7)}$$

Where: L_D = calculated dim light value

-2.7 = equals the OD of the neutral density filter
L_B = measured bright light value

The luminance of the target and background as well as the contrast between the background and target through each of the filter materials, the clear B-LPS, the TOW, and the scene (baseline) were calculated from these measurements.

<u>Procedure</u>: Following a brief question and answer session the volunteers were asked to participate in the experiment. Each volunteer received 30 minutes of practice over a two-day period. Practice on the first day consisted of a block of 11 one-minute trials under both bright and dim (simulated dawn/dusk) ambient light conditions for a total of 22 trials. A one-minute rest break was provided between successive trials and a 10-minute break between the presentation of the two ambient light conditions. This break provided a rest period and allowed for partial dark adaptation prior to tracking under the dawn/dusk light condition. The second day consisted of a block of 15 fifteen-second trials under both bright and dawn/dusk ambient light conditions for a total of 30 trials.

On the test day each person was randomly assigned to one of the two ambient light conditions. The assignment was counterbalanced so that half of the volunteers began under the bright light and half under the dawn/dusk condition. Under both ambient light conditions each person received a set of five baseline control trials (no spectacles) and a set of five trials for each of the three test filters. An additional set of five trials was conducted under both ambient light conditions with a prototype Prime Color Filter. This combination of conditions required that each person track under five different filter conditions (five trials/condition) for a total of 25 trials under each ambient light condition. The presentation order of all of the filter conditions within ambient light levels was randomized.

The dawn/dusk ambient light conditions were controlled by introducing neutral density filters into the optical pathway of the TOW. The amount of neutral density filter added was determined before each set of trials. The ambient light level was measured with a Spectra Mini-spot Spotometer (Burbank, California). Under bright light conditions the light level was measured at approximately 5,000 nits. To create the dawn/dusk conditions the amount of neutral density filter required to reduce the ambient light level to 8.0-8.5 nits was added to the front of the TOW sight. This level was considered to be the upper level of twilight. Additionally, a black cloth shroud was placed over the person's head and shoulders to block the light. This procedure was successfully used in previous studies and was found to produce asymptotic and stable tracking performance (5,6).

Subjective Responses: When individuals are performing a task, perceptions of their physical conditions and subjective feelings (e.g., physical fatigue) are related to performance changes (7). Subjective experience while wearing the B-LPS and tracking targets with the TOW was assessed using the Field Assessment of Laser Protective Spectacles Questionnaire (FALOPS). This questionnaire was given to all participants immediately after they finished tracking. Those parts of the questionnaire which included ratings of items such as clarity and peripheral vision that were assessed on a 1-5 rating scale were correlated nonparametrically with tracking performance.

Statistical Design and Analysis: This study was a 2 (ambient light level) x 5 (goggle configuration) factorial design with both factors treated as repeated measures. The dependent variable(s) were the Root Mean Square (RMS) error score(s) for the X (azimuth) and Y (elevation). These scores were submitted to a 2 x 5 factorial analysis of variance (ANOVA) for repeated measures using BMDP Statistical Software Package (8). Post hoc comparisons of significant findings were tested with the Least Significance Difference (LSD) test (9). Spearman Rank-order correlations were computed to evaluate possible relationships between the questionnaire items and TOW tracking performance data (10). The $P < 0.05$ level was used for determining significance.

RESULTS

RMS Horizontal Error Scores

Fig. 2 presents the horizontal RMS tracking error scores for both the bright ambient light and dawn/dusk conditions. Under the bright light condition the B-LPS Laser Frontsert and the Prime Color Spectacles had the lowest error tracking rates. Comparison among the means for the five filter conditions showed almost no performance differences when compared to the control trials. A different pattern of scores is seen under the dawn/dusk ambient light condition. In each case these scores were always higher than the bright condition and the scores in the trials with the B-LPS

Laser Frontsert and the Prime Spectacles were substantially higher.

Analysis of Variance results (Table I) were in accord with the results seen in Fig. 2. The main effects of ambient light level and filter condition, as well as the interaction of these two factors were significant. The post hoc LSD tests (see Fig. 2 insert, conditions with underlines in common were not significantly different from each other) generally showed significant differences between all of the bright light trials and the dawn/dusk trials. Significant differences were also found when the dawn/dusk control, clear, and sunglasses trials were compared with dawn/dusk Laser Frontsert and Prime Color Filter trials, but the latter two were not significantly different from each other.

The SD estimates for the dawn/dusk trials for the B-LPS Laser Frontsert and Prime Color Spectacles seemed to be relatively high ($\simeq$0.9 mrad). Inspection of the raw data showed that during seventeen of the forty dawn/dusk trials these two filters (involving four of the eight people) had gone beyond the limits of measurement of the system. As the person moved out of the range measurement of the system, during these trials the largest RMS error score possible was recorded and repeated until the person moved back within range of the system. To assess the contribution of these trials to the SD estimates the scores for these trials were deleted and replaced with a mean based on the remaining four trials for each person. With the exception of one filter condition for one individual, this procedure worked well. For that one person only one trial was available; rather than basing his score on a single trial, this score was replaced with the group mean for that condition. This procedure served to reduce the magnitude of the B-LPS Laser Frontsert and Prime Color Spectacle scores by eliminating the trials which produced the largest variability. We then were able to assess the contribution of these trials to over-all effect of dawn/dusk on tracking performance.

These data are summarized in Fig 3. and were evaluated with the ANOVA summarized in Table II. While the pattern of scores for the other conditions remained the same, the means and the SD estimates of the means for the B-LPS Laser Frontsert and Prime

Color Spectacles under the dawn/dusk condition were lower. The ANOVA results and the post hoc tests were almost identical except under dawn/dusk conditions in which the B-LPS Laser Frontsert scores were again significantly larger than the control and clear filter trials, but they were not significantly different from the trials in which the sunglasses were worn.

Subjective Reports

The ratings from the FALOPS Questionnaire taken immediately following the last tracking trial for each person were correlated with the TOW tracking data. The correlations of interest were those between the RMS tracking error scores and the ratings of the items that reflected their visual experience while wearing each of the spectacles. The results of these Spearman's Rank Order Correlations indicated that none of these relationships were statistically significant (i.e., $\geq$0.71).

Scene Photometry, Chromaticity, and Contrast

The results of the Imaging Radiometer and the Varian Spectrophotometer for each of the test conditions are summarized in Tables III and IV. The effective luminance (e.g., as perceived by the eye) measurements ranged from 893 down to 43 nits during the bright light trials and from 1.411 to 0.068 nits during the dawn/dusk trials (Table III). In each case the background was brighter than the target. The u,v chromaticity coordinates (u,v) for each condition indicated the color of the scene through both the TOW and the clear B-LPS to be nearly alike. These values for the B-LPS Frontsert indicated that with the reduced transmission of light at the red end of the spectrum, the scene tended to appear slightly green. For the sunglasses and the Prime Color Spectacles, the changes in the chromaticity coordinates indicated that the color of the scene shifted toward the yellow. The luminance transmission values obtained with the TOW and the TOW in combination with each of the filters ranged from approximately 54% down to 4% (the lowest values were for the Prime Color Filter). The contrast between the target and background were almost identical (21-22%) for each filter condition. The luminous transmission values for the TOW and each filter were calculated for a CIE C source and presented in Table IV. These values ranged downward from 0.75 for the clear B-LPS to 0.07 for the Prime Color Filter.

CONCLUSIONS AND RECOMMENDATIONS

The tracking performance results obtained during this study under the bright ambient light conditions compare favorably with results obtained during our earlier work with prototype laser ocular protective materials (4). Under the bright light conditions in both studies, none of the filters that were evaluated would impair a TOW operator's ability to track a moving target. In fact, in the present study there is a very slight (not significant) improvement with the B-LPS Laser Frontsert and Prime Color Spectacles. It is possible that these goggles may reduce some of the scattered incident light that would lead to improved visual acuity.

However, under conditions where the eye is operating in marginal lighting conditions, differences can be seen. Since the effect of the B-LPS Laser Frontserts and the Prime Color Spectacles on light entering the eye is substantially different (see Fig. 1) a simple explanation for the approximately equally increased RMS error scores is not plausible. While the luminous transmittance for the B-LPS is relatively high (i.e., photopic = 47%, scotopic = 56%) the prime color spectacles is low (i.e., photopic = 12.7%, scotopic = 6.9%) (Fig. 1). However, the chromaticity coordinates for the B-LPS indicated that as visible light at the red end of the spectrum was substantially reduced, the scene became more greenish in appearance. This change in the scene as the green camouflaged target was moving through the green and brown background probably added to the difficulty in seeing the target and thus increased tracking error scores. The chromaticity coordinates for the Prime Color Filter showed a shift toward the yellow portion of the spectrum which could have made tracking a dark object easier relative to the change in the scene created by the B-LPS laser Frontsert.

In the present study the target/background contrast was low (ranging from 21-22%). Evaluation of the pairs of chromaticity coordinates for the target and background in Table III also shows this to be true. While the contrast was not measured in the earlier study by Levine et al. (4), the apparent contrast was better since the relatively dark camouflaged vehicle was contrasted against a light sandy colored road. In the present study the dark camouflaged target moved through a background of similarly colored greens, browns and blacks. This may have contributed to the slightly higher error scores under dawn/dusk conditions in the present study.

One of the filter conditions in the Levine et al. study (4) was a 1.0 OD neutral density filter that was similar to the 0.7 OD sunglasses used in the present study. The error tracking scores under dawn/dusk conditions in both studies were similar (approximately 0.5 mrad) and lower than the B-LPS laser Frontsert and Prime Color spectacles. This finding suggests that under extreme and difficult conditions some degradation in performance may be found. Under photopic conditions performance should not be impaired, and in fact may be improved with the use of these spectacles.

Molchany et al. (11) conducted a laboratory pursuit tracking study in which the ambient light level was reduced using neutral density filters. The target-to-background level was 37% as compared with the present study in which the contrast was 21-22%. Molchany did not achieve the same degree of RMS error as we found for the B-LPS sunglasses in the present study until the ambient light level was reduced to 0.01 nits. This finding emphasizes the importance of contrast between the target and background when attempting to account for performance differences among various types of filters.

The lack of any significant relationship between subject reports on the questionnaire items and tracking performance is not totally surprising. In the earlier Levine et al. study (4) one of the items tested was Schott BG-18 glass. When volunteers were questioned concerning BG-18, the general consensus was that they would not want to use it under any condition. Tracking performance with BG-18 under bright ambient light conditions was not appreciably different from the other materials despite subjective reports by troops which indicated they did not like having this material in front of their eyes. Acceptability of laser ocular protective material by soldiers apparently depends on factors other than crosshair placement and target tracking. Factors such as trueness of color rendition, prismatic deviation, and overall comfort must be studied. However, for the present, performance data obtained under field conditions requiring near threshold vision will continue to provide a critical analytical comparative assessment of protective eyewear attributes. This procedure has enabled us to select the best test materials for use in the field and should increase user acceptability of these items.

Laser radiation inadvertently aimed at friendly troops during training exercises or deliberately aimed at soldiers in combat, to exploit the vulnerability of the human eye, represent a current threat to friendly forces. Our first countermeasure to the threat's laser systems will enable our friendly forces to continue to perform their jobs assured that their eyes will be protected from catastrophic injury and that medical casualties from laser ocular injuries will be minimized. Since the B-LPS may precede laser hardening of many systems, it is important to determine if wearing the B-LPS will affect the appearance of the visual scene or interfere with the performance of military tasks which require the use of vision. The present study has shown that the B-LPS can be used with a direct view system such as the TOW under conditions where adequate luminance transmittance exists. Performance with the B-LPS under these conditions will not be degraded. However, it should be noted that the ground-mounted TOW used in the present study provided an unobstructed access to the monocular eyepiece. In other systems performance may be affected by items such as forehead padding that may change the standoff distance of the eye with respect to the ocular. (These measurements were made with the TOW used in the present study and presented in another report (12).) As with many systems and equipment provided for soldiers, some training may be required to avoid using the B-LPS under conditions where they could interfere with visual performance tasks. The very minimal reduction in performance experienced under marginal visual conditions is certainly offset by the ballistic and laser protection afforded by the B-LPS. The results thus far are encouraging.

SUMMARY

- O Under bright ambient light conditions the use of the B-LPS will not affect tracking performance.

- O Under extreme dawn/dusk conditions some decrement in tracking performance may be found.

- O Subjective reports on questionnaire items were not related to tracking performance.

ACKNOWLEDGMENTS

To conduct a field study requires the patience and cooperation of many individuals. We acknowledge the technical support of SPC Walter Bennett, SPC Peter Edsall, MS Julie Quang, and the logistical support of SSG. Ventura Rodriguez. We also acknowledge the dedication of the volunteers who under difficult conditions, strove to provide us with the best data possible. We also appreciate the design and analysis support of Dr. Virginia Gildengorin and the editorial evaluation of Mrs. Susan Siefert.

TABLE I
ANOVA Summary of RMS Error Scores by Filter Condition and Ambient Light Level

Source	Sum of Squares	Degrees of Freedom	F	Probability
Mean	16.85	1	58.78	P=0.0001
Error	2.01	7		
Light Level	3.17	1	12.12	P=0.01
Error	1.83	7		
Filter	0.77	4	4.31	P=0.008
Error	1.24	28		
Light/Filter	0.98	4	6.97	P=0.0005
Error	0.98	28		

TABLE II
ANOVA Summary of Revised RMS Error Scores by Filter Condition and Ambient Light Level

Source	Sum of Squares	Degrees of Freedom	F	Probability
Mean	13.37	1	97.27	P=0.0001
Error	0.96	7		
Light Level	1.77	1	15.68	P=0.006
Error	0.79	7		
Filter	0.10	4	2.38	P=0.08
Error	0.30	28		
Light/Filter	0.18	4	4.46	P=0.006
Error	0.28	28		

TABLE III
Target and Background Luminance, Chromaticity and Contrast for All Filter Conditions

Test Condition	Source	Luminance (nits) Bright	Luminance (nits) Dawn/dusk	Chromaticity (u,v)	Luminous Transmittance (Photopic,	Scotopic)	Contrast (%)
Baseline	Target	579	0.915	0.210, 0.486	1.000	1.000	21
	Background	893	1.411	0.204, 0.476	1.000	1.000	
TOW	Target	317	0.501	0.208, 0.502	0.548	0.513	21
	Background	489	0.773	0.202, 0.494	0.548	0.510	
TOW+ B-LPS	Target	236	0.373	0.208, 0.502	0.408	0.384	21
	Background	364	0.575	0.202, 0.494	0.408	0.382	
TOW+ B-LPS+ Frontsert	Target	109	0.172	0.142, 0.505	0.188	0.217	22
	Background	170	0.269	0.139, 0.498	0.190	0.216	
TOW+ Sun Glasses	Target	71	0.112	0.245, 0.521	0.123	0.083	21
	Background	108	0.171	0.238, 0.516	0.122	0.082	
TOW+ Prime Color	Target	43	0.068	0.245, 0.522	0.074	0.038	21
	Background	66	0.104	0.241, 0.518	0.073	0.037	

TABLE IV
Luminous Transmittance for a CIE C Source

Ambient Light Level	TOW	Clear B-LPS	B-LPS Laser Filter	B-LPS Sun Glasses	Prime Color Filter
Photopic	0.55	0.74	0.35	0.22	0.12
Scotopic	0.51	0.75	0.42	0.15	0.07

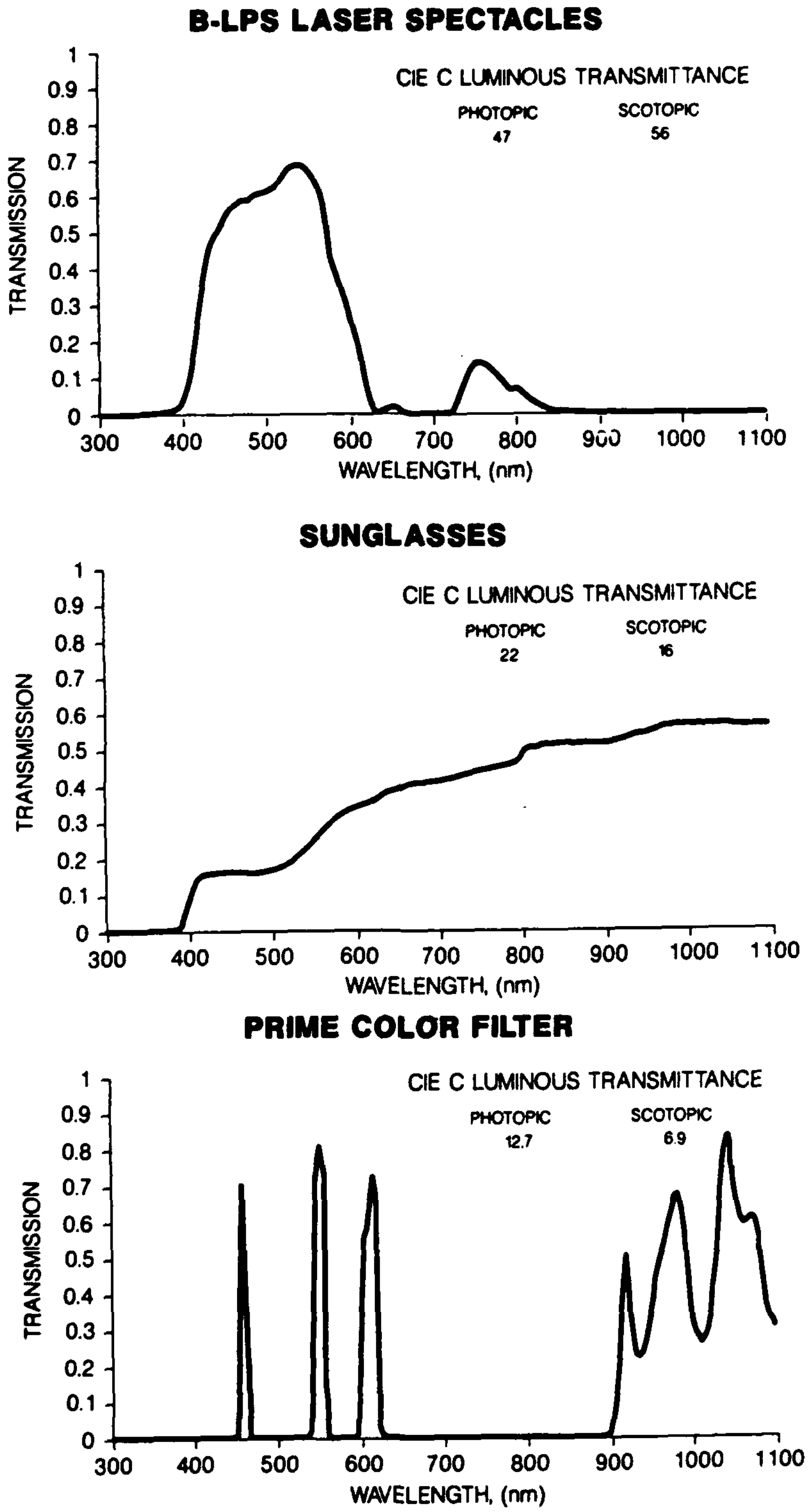
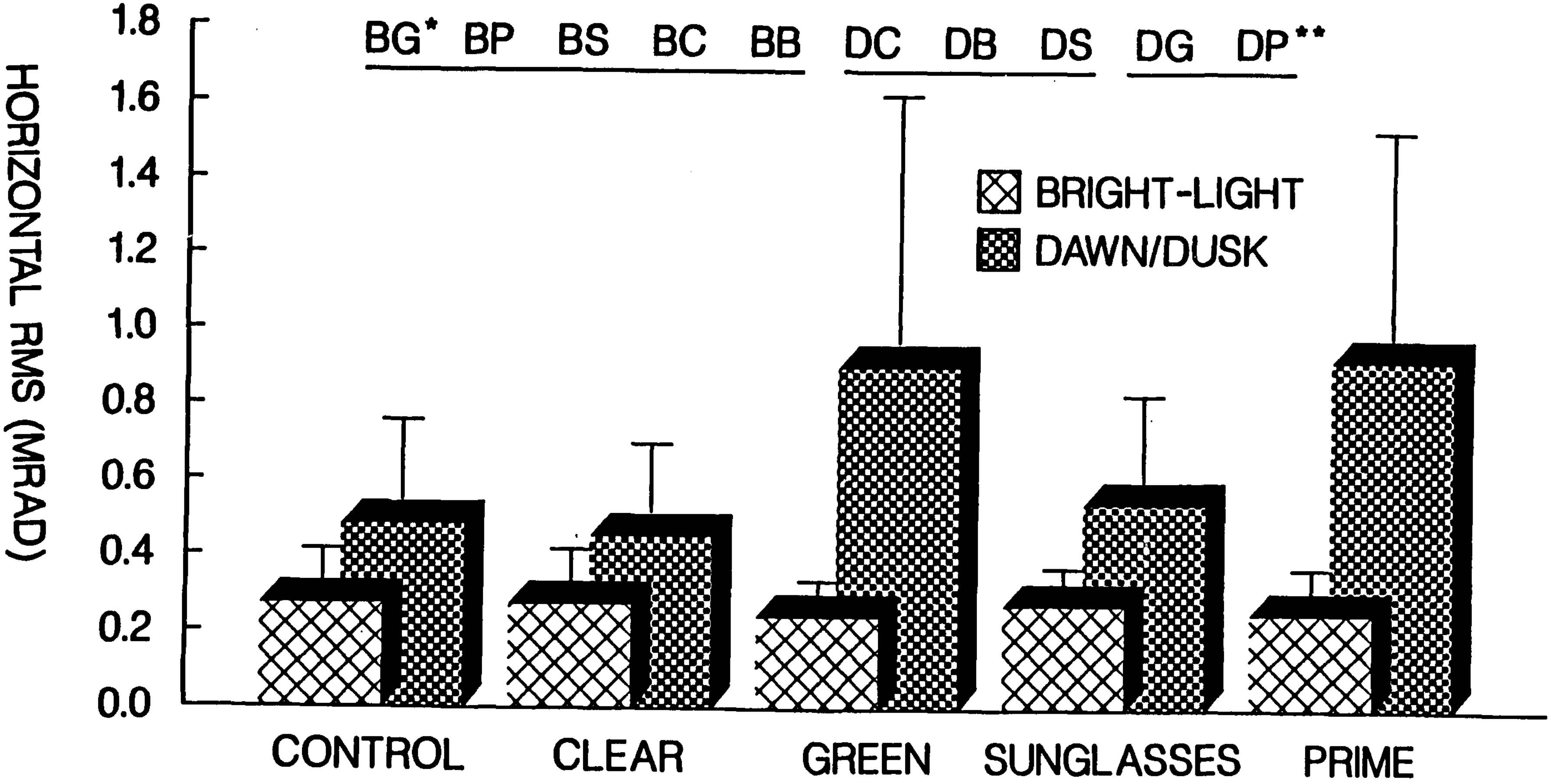


FIGURE 1 Transmission curves for the B-LPS laser spectacles, B-LPS sunglasses, and prime color spectales.

FIGURE 2

HORIZONTAL RMS ERROR SCORES.

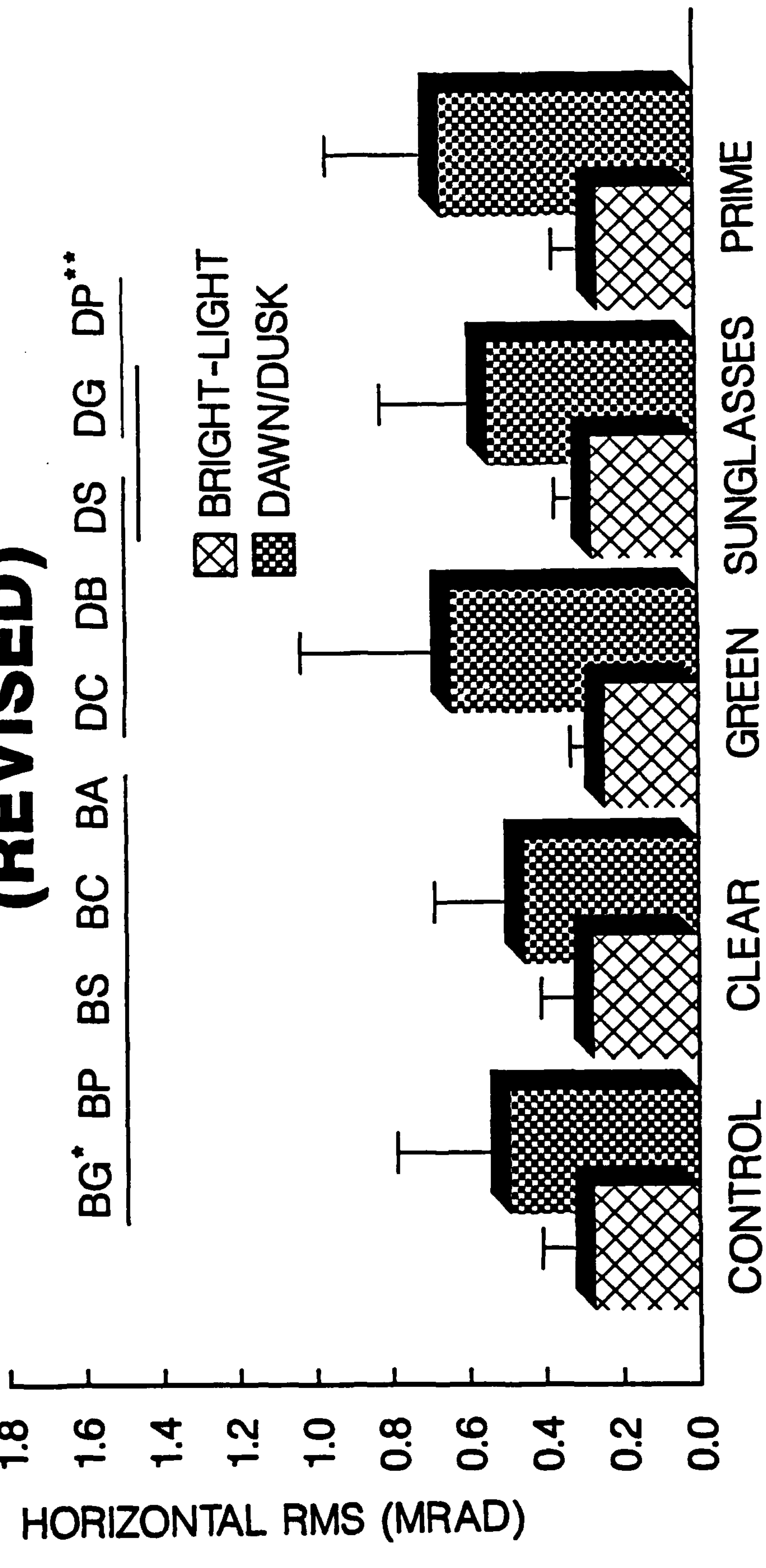


*Note. - B = Bright; D = Dawn/Dusk; G = Green; P = Prime; S = Sunglasses; C = Clear; B = Baseline.

**Note.-Conditions with underlines in common were not significantly different from each other.

FIGURE 3

HORIZONTAL RMS ERROR SCORES. (REVISED)



*Note.-B = Bright; D = Dawn/Dusk; G = Green; P = Prime; S = Sunglasses; C = Clear; B = Baseline.
**Note.-Conditions with underlines in common were not significantly different from each other.

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APPENDIX

FIELD ASSESSMENT OF LASER OPTICAL PROTECTIVE SPECTACLES QUESTIONNAIRE

Appendix - Abbreviated FALOPS Questionnaire

NAME ____; AGE________

APPENDIX - ABBREVIATED FALOPS QUESTIONNAIRE

Use the following categories to evaluate each B-LPS goggle:

1 = Very good; allowed normal function without discomfort.
2 = Good; permitted normal function with minor discomfort.
3 = Borderline; caused some interference with normal function or moderate discomfort.
4 = Poor; caused considerable interference of normal function or sense of discomfort.
5 = Very poor; caused considerable interference with normal function and severe discomfort.

Ballistic Spectacles (Clear Eyepieces)

(Circle one)

	very good,	good,	borderline,	poor,	very poor
General Visibility	1	2	3	4	5
Depth Perception	1	2	3	4	5
Peripheral Vision	1	2	3	4	5
Clarity	1	2	3	4	5
Glare	1	2	3	4	5
Colors of Objects	1	2	3	4	5

Laser Spectacles (Green Frontserts)

(Circle one)

	very good,	good,	borderline,	poor,	very poor
General Visibility	1	2	3	4	5
Depth Perception	1	2	3	4	5
Peripheral Vision	1	2	3	4	5
Clarity	1	2	3	4	5
Glare	1	2	3	4	5
Colors of Objects	1	2	3	4	5

Sunglasses (Brown Eyepiece)

(Circle one)

	very good,	good,	borderline,	poor,	very poor
General Visibility	1	2	3	4	5
Depth Perception	1	2	3	4	5
Peripheral Vision	1	2	3	4	5
Clarity	1	2	3	4	5
Glare	1	2	3	4	5
Colors of Objects	1	2	3	4	5

Tri-Stimulus Filter

(Circle one)

	very good,	good,	borderline,	poor,	very poor
General Visibility	1	2	3	4	5
Depth Perception	1	2	3	4	5
Peripheral Vision	1	2	3	4	5
Clarity	1	2	3	4	5
Glare	1	2	3	4	5
Colors of Objects	1	2	3	4	5

Check yes or no:

Do the B-LPS feel uncomfortable in any way? ___ yes ___ no

Explain ____

____

Do the B-LPS rub your nose excessively? ___ yes ___ no

Explain ____

____

Do you wear glasses (spectacles)? ____ yes ____ no

Do you wear contacts? ____ yes ____ no

If you wear contacts, which type? ____ hard ____ soft

Do you think the B-LPS interfered with your ability to track the target? ____ yes ____ no.

If yes, explain ____

____

____

<u>General Comments</u>

What did you DISLIKE about using the B-LPS? ______________

____

____

____

____

What did you LIKE about using the B-LPS? ________________

____

____

____

____

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